Soil Quality, Moisture, and Temperature Evaluation under Different Biodegradable Mulches

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Introduction

- Biodegradable plastic mulch (BDM) can substitute conventional polyethylene mulch (PE).
- BDM can be soil incorporated after usage, alleviating disposal costs.
- Microclimate and BDM impact on agricultural soil ecosystems needs to be evaluated.

Objectives

- Examine light, temperature, and moisture flow dynamics in BDM plots.
- Evaluate BDM effects on soil quality and potential for ground water pollution.

Materials and Methods

Locations: Established in 2015 at Knoxville, TN and Mount Vernon, WA.

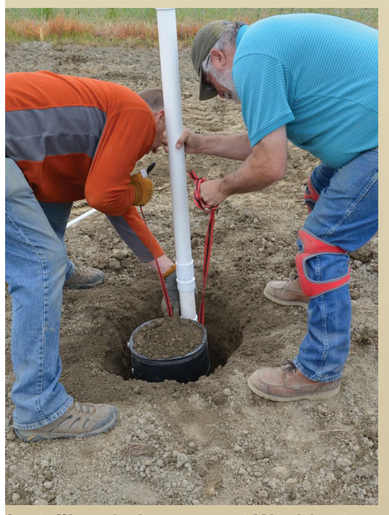
Soil quality: Tested soil biological, physical, and chemical parameters (Table 1).

Treatments: Four BDMs, plus bare ground, paper mulch, and PE as controls.

Test crop: Pie pumpkin (*Cucurbita pepo*)

Instrumentations:

- ✓ *Decagon 5TM sensors at 10 and 20 cm soil depths.*
- ✓ *Hobo Pendant Temperature/Light Data Loggers at soil surface or directly underneath mulches (WA only).*
- ✓ *Drain Gauge G3 at 55 cm depth (WA only).*
- ✓ *Suction lysimeters at 30 cm depth (TN only).*



Installing drain gauge at Washington

Sampling for initial soil quality assessment at Tennessee

Priming drain gauge

Installing soil sensors

Knoxville, TN field site after mulch installation.

Mount Vernon, WA field site 3 wks after transplanting .

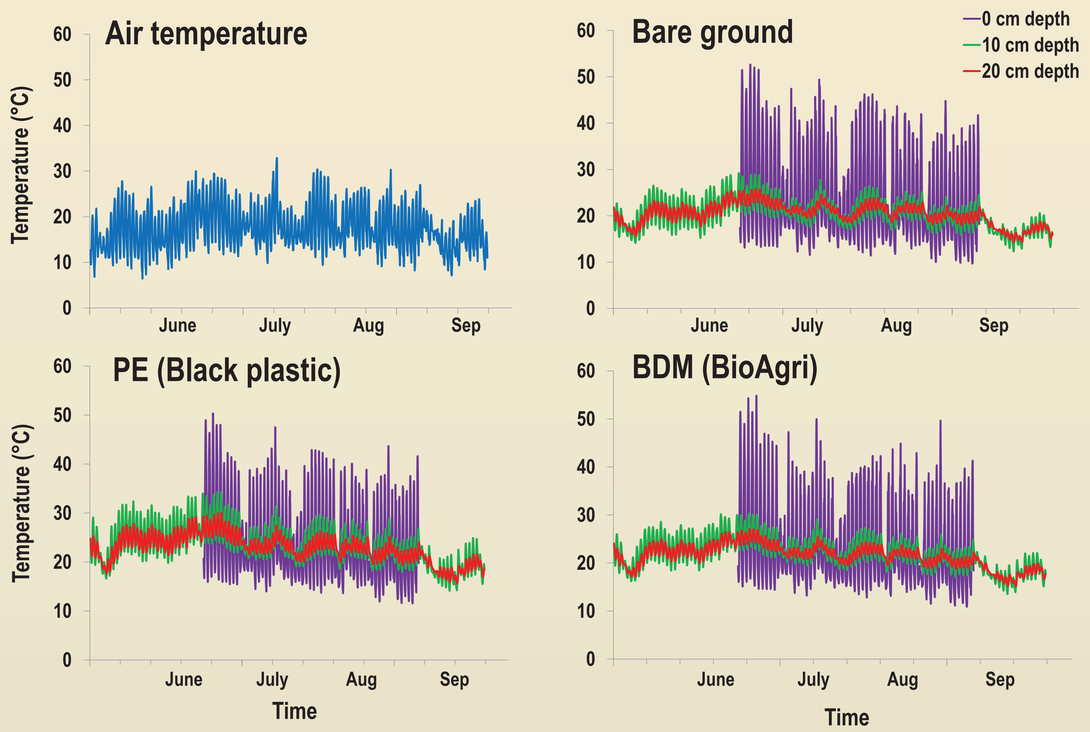


Fig. 1. Hourly air and soil temperatures at 0, 10 and 20 cm depths for bare ground, PE, and BioAgri at Mount Vernon, WA.

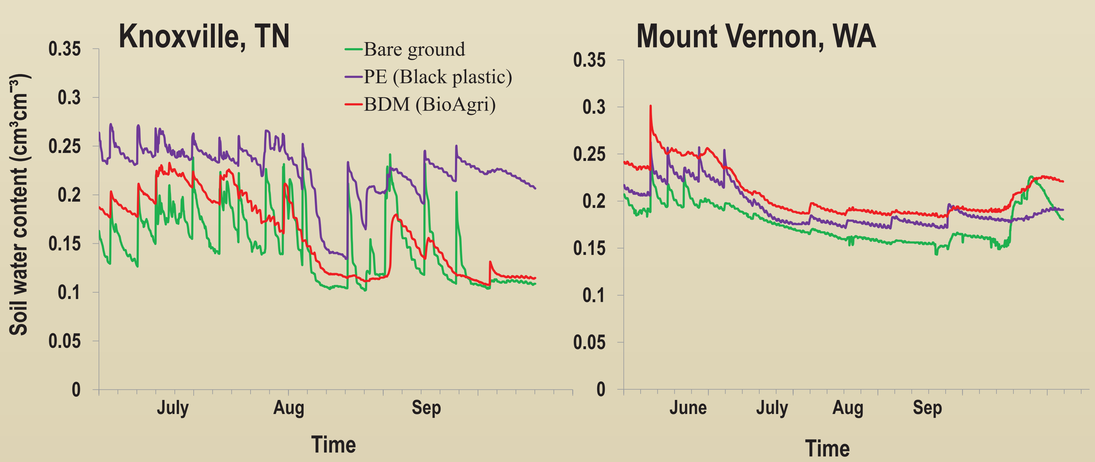


Fig. 2. Hourly soil water content of bare ground, PE, and BioAgri at 20 cm soil depth Knoxville, TN and Mount Vernon, WA.

Site	Soil texture	Agg. Stability %	Bulk density g cm^{-3}	Organic matter %	Soil respiration kg CO_2 ha^{-1} d^{-1}	Soil pH	Soil EC dS m^{-1}	NO_3-N kg ha^{-1}
KV	Sandy L.	23.7	1.41	1.43	56.9	6.1	0.07	32.0
MV	Silt L.	25.3	1.31	2.36	20.3	6.6	0.03	13.7

Table 1. Initial soil characteristics at Knoxville and Mount Vernon field sites.

Results

Microclimate:

- ✓ *Soil temperature was less variable to depth increase in all the mulch treatments (Fig. 1). The maximum soil temperature at 0, 10, 20 cm soil depths was 54.8, 34.3, and 30.0 ° C, respectively.*
- ✓ *Soil water content differed in mulch treatments at both sites. Bare ground was generally dryer throughout the season at Mount Vernon, WA and during early crop season at Knoxville, TN (Fig. 2).*
- ✓ *The mulches reduced light penetration by more than one hundred thousand lux (Fig. 3). Overall, the PE mulch treatment was the most effective in preventing light penetration.*

Soil quality: No effects of BDM on the soil quality parameters tested after first year cropping season.

Drainage: No water drainage during the growing period.

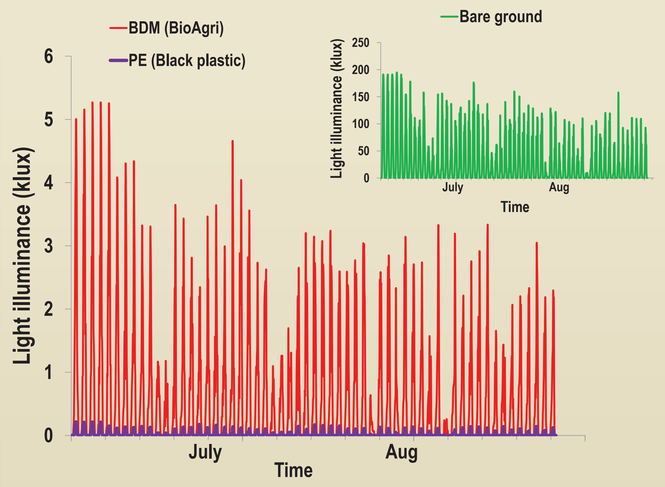


Fig. 3. Hourly light penetration of Bare ground, PE, and BioAgri at Washington.

Conclusions

Microclimate varies with mulch type, which affects crop growth and productivity. There were no effects of the mulch treatments on soil quality.

Acknowledgement

This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2014-51181-22382. We acknowledge farm crews at TN and WA for their support, and Decagon Devices for providing instrumentations.